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Group 5: Order Artiodactyla – Suborder Tylopoda (Family Camelidae)

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Introduction

The family **Camelidae** (suborder *Tylopoda*, order *Artiodactyla*) comprises seven extant species split between Old World (OW) and New World (NW) camelids. OW camelids include the single-humped dromedary (*C. dromedarius*), double-humped Bactrian (*C. bactrianus*) and wild two-humped camel (*C. ferus*)[1][2]. NW camelids consist of the llama (*L. glama*) and guanaco (*L. guanicoe*) (genus *Lama*), and the alpaca (*V. pacos*) and vicuña (*V. vicugna*) (genus *Vicugna*)[1][10]. All are herbivorous *pseudo-ruminants* with three-chambered stomachs (analogous to rumen, omasum, abomasum)[3]. Camelids diverged early in artiodactyl evolution and are grouped in Tylopoda ("padded foot") due to unique foot anatomy[3]. Domestic camels were among the earliest domesticated livestock: OW camels ~4000 B.C. in the Arabian region[1], and NW camelids (alpacas, llamas) ~6000 B.C. in the Andes[10]. Camelids now number ~20 million globally, predominantly dromedaries in arid Africa and Asia. This report reviews camelid biology and veterinary aspects crucial for veterinary students and practitioners.

Taxonomic Classification

Rank	Taxon
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Artiodactyla (even-toed ungulates)
Suborder	Tylopoda (padded-footed)
Family	Camelidae
Subfamilies	Camelinae (OW camels), Laminae (NW camelids)[1]
Genera (Camelinae)	*Camelus* (3 species: *C. dromedarius*, *C. bactrianus*, *C. ferus*)[1][2]
Genera (Laminae)	*Lama* (2 spp: *L. glama*, *L. guanicoe*), *Vicugna* (2 spp: *V. pacos*, *V. vicugna*)[1][10]

Comparative Traits vs Ruminantia: Camelids have nail-covered foot pads rather than cloven hooves[3]. They are obligate nasal breathers (no oronasal pathway), have three stomach compartments instead of four[3], and their erythrocytes are elliptical and smaller than typical ruminant RBCs (an adaptation to dehydration and high-altitude hypoxia[6]). Like ruminants, camelids possess a dental pad in the upper jaw and complex stomachs, but they lack a gallbladder. Camelids (all genera) are *induced ovulators* and most are seasonal breeders, unlike spontaneous-ovulating cattle/sheep[11]. Gestation is long: ~390–440 days in *Camelus* spp.[12] versus ~335–350 days in llamas/alpacas[13]. See Table 1 for a systematic taxonomy.

Table 1. *Taxonomic classification of family Camelidae (Tylopoda).*

Taxonomic Level	Camelidae Classification
Order	Artiodactyla (even-toed ungulates)
Suborder	Tylopoda (padded-footed)
Family	Camelidae
Subfamily	Camelinae (*Camelus*: one-hump dromedary, two-hump Bactrian, wild Bactrian)[1][2]; Laminae (*Lama*, *Vicugna*: llama, guanaco, alpaca, vicuña)[10]
Genus/Species	*Camelus dromedarius*, *C. bactrianus*, *C. ferus*; *Lama glama*, *L. guanicoe*; *Vicugna pacos*, *V. vicugna*[1]

Habitat, Distribution, and Ecology

Camelids are adapted to harsh environments. OW camels thrive in arid deserts and semi-deserts of North Africa, the Middle East, and Central Asia, where daytime temperatures and limited water pose challenges[4]. NW camelids occupy the high-altitude Andes (alpacas, vicuñas) or Patagonian steppe (guanacos)[14]. For example, vicuñas are restricted to 3,400–5,400 m elevations in the Andes, grazing on sparse alpine grasses[15]. Alpacas and llamas are farmed throughout Andean regions[15]. Camels are tolerant of extreme heat and drought: they can fluctuate body temperature over ~7 °C daily (34–41.7 °C) to conserve water, tolerate >30% dehydration (lethal for most mammals at ~15% loss) and can drink ~100 L of water in one session[4].

Camels in their arid habitat: Old World camels are built for desert life, with padded feet and water-saving physiology[3][4]. They roam sand dunes and semi-desert plains where food is sparse.

In contrast, NW camelids face cold, hypoxic conditions. Alpacas and llamas have dense fleeces and physiological adaptations (small, elliptical red cells; high hemoglobin and myoglobin) to extract oxygen efficiently at altitude[6]. They thrive on low-nutrient forage in high Andean plateaus. Distribution of NW species overlaps but differs: llamas are widespread in Andean countries, while wild guanacos remain abundant in Patagonia[14]. Camelids' ability to forage on tough, dry shrubs and endure water scarcity (through concentrated urine and dry feces) is key to their ecology[4][6].

Anatomy

External Anatomy

Camels have a long, arched neck; males are ~10% larger than females[16]. Skin is thick to resist the sun and insects. Their feet have two toes with broad, leathery pads (no horns or claws)[3]; this spreads weight on sand and prevents sinking. Camels' upper lip is bifid and tough to browse thorny plants[17]. Long eyelashes and closable nostrils protect eyes and airways from sand[4]. One (dromedary) or two (Bactrian) fatty humps on the thoracolumbar region store fat (insulates and fuels metabolism in lean times)[18]. NW camelids lack humps but have thick fiber for insulation[8][10].

Head and Dentition

Camels have a split upper lip and a tough tongue for browsing spiny forage[17]. They lack upper incisors, instead having a hard dental pad; lower jaw has three broad incisors per side. Canines are present (curved), and their molars are selenodont (complex ridges)[19][20]. The dental formula for the dromedary is 1/3, 1/1, 3/2, 3/3 (Incisors, Canines, Premolars, Molars) in each quadrant[16]. They masticate coarse feed with lateral grinding motions, similar to ruminants.

Digestive System

Camelids are **pseudo-ruminants** with a three-chambered stomach: C1 (rumen-like), C2 (reticulum-like), and C3 (abomasum-like)[3]. C1 and C2 mix and ferment plant material; C3 (distal two-thirds) secretes acid and enzymes. They chew cud and have a complex microbial flora to digest fiber. Gastric tufts act like omasum in ruminants. Camelids lack a true gallbladder. They have large salivary glands for lubrication. The spiral colon (spirointestinal complex) absorbs water efficiently; >25% of ingested water is reabsorbed in the colon of NW camelids (versus ~10% in cattle)[6]. Feces are typically dry, pelleted, conserving water. The oesophageal groove reflex (common to ruminants) closes the esophagus to shunt milk in suckling young directly to C3.

Respiratory and Cardiovascular Systems

Camels have large lung capacity and low respiratory rate. Unique adaptations include ability to widen nostrils and a hairy internal nostril to keep out sand. Blood oxygen affinity is high; their erythrocytes are oval and more pliable, aiding blood flow when dehydrated or under heat stress. These RBC and hemoglobin adaptations (especially in NW species) support oxygen delivery at altitude[6]. The heart and vessels are similar to other ungulates, but camels have pronounced dehydrated blood shifts – up to 40% of body water can move into the circulation during rehydration. Basal aortic temperature in camels can differ from core temperature by >5 °C, a unique feature to minimize heat gain.

Musculoskeletal System

Camel limbs are long for striding; gait is pacing (both legs on one side move together). The forelimbs have prominent acromion and scapular spine. Camelids have five digits per limb but walk on only two (II and III) with strong sesamoids; digits I and V are absent, IV and V vestigial. The footpad is flexible. Limb joints and musculature support carrying heavy burdens and standing long periods. Camel vertebrae are well-muscled; two humps in Bactrians correspond to extra fat and muscle attachments. Clavicles are rudimentary; the long neck has strong nuchal ligament. Dental and jaw musculature is robust for chewing fibrous feed.

Integument and Hair

Camels have sparse fur with seasonal shedding: winter coats are long, dense, and woolly (especially in two-humped camels), shedding in warmer months. Skin is thick and has subcutaneous fat deposits. NW camelids have thick fleece undercoat (used as fiber) with coarser guard hairs. Skin on chest and knees often thickens due to kneeling behavior. Sebaceous glands provide limited oily protection; wool also insulates. Camelids sweat and pant but less than other mammals, aided by rising body temperature.

Unique Adaptations

Camelids possess remarkable adaptations for extreme environments. **Water Economy:** Camels conserve water by allowing large fluctuations in body temperature and by highly efficient renal and intestinal water reabsorption[4][6]. Dromedaries can lose up to 30% body water without ill effect[4] and rehydrate quickly (100 L in ~10 min)[21]. Their kidneys produce very concentrated urine; fecal pellets are dry. NW camelids absorb >25% of luminal water in the spiral colon (vs ~10% in cattle)[6].

Thermoregulation: By tolerating hyperthermia, camels minimize sweating. Their coat reflects sunlight; humps (fat stores) insulate core from external heat[18]. Hump fat is metabolized during fasting or drought, acting as energy and water source (metabolism of 1 g fat yields ~1.07 g water).
Blood: Camelid RBCs are elliptical, smaller, and more numerous, with high hemoglobin concentration. This, along with hemoglobin's high oxygen affinity, enables efficient oxygen transport in hypoxic high-altitude conditions[6]. These erythrocytes swell without lysing when large volumes of water are absorbed rapidly (after rehydration) – an adaptation to rapid water intake.
Foot Structure: They walk on the soft tissues of the footpad instead of hard hooves[3]. The two toes spread to distribute weight on sand and rocky ground. Footpads are tough and leathery. In NW camelids (llamas, etc.), the nail (small hoof) covers the dorsal aspect of each toe pad. This unique foot structure ("pads") earns the suborder name Tylopoda[3].
Hump Physiology: The hump acts as an insulator and metabolic reservoir. It keeps body heat off the torso and provides fat and water when resources are scarce[18]. Approximately 84% of the hump's weight is lipid[18], equating to ~5–8% of the animal's body weight in stored fat[22]. This is mobilized during starvation, and the raised hump profile declines.

Adaptation example: A camel in the desert at dusk illustrates its thick fur, nostril closure, and gait. Its broad footpads (visible here) allow safe travel on sand[3][4]. The fatty hump (right) supplies energy when forage is scarce.

Feeding and Nutrition

Camelids are **herbivorous browsers/grazers**. Dromedaries eat arid-adapted browse (acacia, hardy shrubs), often thorny plants that other livestock avoid[16]. Llamas/alpacas in the Andes graze grasses and forbs; llamas tolerate coarser forage than alpacas[23]. They require a diet high in fiber; concentrate overload can cause acidosis. Typical feed includes hay (legume or grass) and limited grain. Nutrient requirements vary by species and production stage: e.g. an adult camel (~600 kg) needs about 2–2.5% body weight as dry matter intake per day, higher in pregnancy/lactation. Vitamins A and D are supplied by sunlight and roughage; vitamin E/Se deficiency can occur (white muscle disease in neonates).

Water is required daily, but camelids can endure long periods without it. When available, camels drink up to 100 L at once. Management systems: Camels may be free-grazed or stall-fed; proper hoof-trimming is needed if kept on hard ground. Alpacas/llamas are often in fenced paddocks with supplemental hay; they should be fed separate from sheep to avoid parasite transfer. **Pasteurellosis and other diseases** can relate to poor nutrition. Minerals: Provide salt blocks and ensure trace minerals (Cu: 4-6 ppm in liver, alpacas very sensitive to Cu toxicity). Llamas/alpacas benefit from nutrient-dense paddocks in lean season; overweight is less problematic than in sheep.

Reproduction and Neonatology

Camelids are generally **seasonal and induced ovulators**. In alpacas/llamas, ovulation is triggered by an ovulation-inducing factor in seminal plasma[11]. Female reproductive anatomy: bicornuate uterus with a small body; cervix with 2–3 cartilaginous rings; placenta is diffuse epitheliochorial. Males have pendulous testes and produce small ejaculate (~2–5 mL) deposited directly into uterus after cervical dilation[11]. Gestation length is long: ~335–345 days in alpacas, ~340 ± 10 in llamas[13]. Camels gestate ~370–440 days (often ~390 days)[12]. Calves are usually singletons. Sexual maturity: camels ~3–5 years, llamas/ alpacas ~1–2 years (typically bred after 2 years due to dystocia risk)[11]. Season: OW camels mate in cool season (winter)[24]; NW camelids cycle in fall-winter but can breed year-round under management.

Parturition: Typically occurs during daylight hours. Stage II labor is short (<30 min) with immediate birth of a precocial neonate. Females have 4 teats, one juvenile per birth. Neonates stand within 15–45 min and nurse by 1 h[25]. Crias should double birth weight by 1 month.

Neonatal care: Ensure colostrum intake of 10–15% body weight within 12 h[26]. Newborn vitals (see Table 2) are roughly similar to adult (Temp ~37.8 °C, HR ~60–90, RR ~30 in NW crias[27]). Dip the umbilicus with antiseptic immediately. Monitor for choanal atresia (obligate nasal breathers) by observing nasal condensation[28]; bilateral atresia is fatal without surgery. Failure of passive transfer is common[29]; test IgG at 18–24 h (gold standard: radial immunodiffusion) and supplement colostrum or plasma if IgG <1000–1500 mg/dL[29]. Premature crias show silky fur and may need intensive care[30].

Neonatal care: A newborn alpaca cria (shown) relies entirely on maternal care. Crias must receive 10–15% of their weight in colostrum within hours of birth[31] to acquire immunity. Proper bedding, navel disinfection, and monitoring (weight gain ~100–250 g/day in alpacas) are vital[32][31].

Clinical Examination and Normal Parameters

A systematic exam of camelids mirrors other large animals but tailored to species temperament (often requiring restraint in a chute or sedation). Key steps: observe in motion (gait, posture, awareness), inspect body condition and fleece, check mucous membranes (caution: camels have longitudinal pupil, long eyelids), palpate submandibular and prescapular lymph nodes, auscultate lungs and heart (noting double lobulation of rumen and forestomach sounds), examine abdomen (percuss and auscultate all "gastric compartments"), palpate limbs/hooves, and examine urogenital tract (transrectal palpation is possible in llamas >45d gestation, usually too large for alpacas). Fluids (ocular fluid may be collected for electrolytes in field). Joint and nerve assessment as needed.

Normal Vital Signs vary by species and age. Table 2 summarizes typical values for adult camelids. (Note: camels show wide diurnal temp variation.)

Table 2. *Normal clinical parameters by species and age.*

Parameter	Dromedary (adult)	Bactrian (adult)	Llama/Alpaca (adult)[9]	Neonatal Llama/Alpaca[27]
Rectal Temp	34–40 °C†	~34–40 °C†	37.5–38.9 °C (36.2–38.6)[9]	~37.8 °C
Heart Rate (bpm)	30–50§	30–50§	60–90[9]	60–90[27]
Resp. Rate (rpm)	8–20*	8–20*	10–30[9]	~30[27]
Ruminal/Forestomach contractions	1–2/min	1–2/min	1–3/min (lamas)	—
Capillary refill	<2 sec	<2 sec	<2 sec	<2 sec
PCV (%)	35–40† (Hb ~18–22 g/dL)	similar†	30–50 (alpacas higher)	30–50
Notes: † Range broad due to diurnal change[5]. §At rest in shade; may increase with exertion. *Increased if panting.				

(If precise data unavailable for some species or neonates, “unspecified” would be noted.)

Common Diseases

Camelids are susceptible to many of the same diseases as other ruminants and camelid-specific conditions. Table 3 summarizes major diseases. Detailed discussion follows.

Infectious Diseases:

- **Poxviruses:** *Camelpox* (Orthopoxvirus) is ubiquitous in OW camelids (Africa, Middle East, Asia)[33]. Signs range from mild skin papules to generalized vesicular eruptions and death in young. Lesions occur on skin and oral/respiratory mucosa[34]. Mortality in adult camels is 5–28%, but can approach 25–100% in young[35]. Diagnosis: clinical + EM/PCR of scabs[36]. Vaccination is practiced in endemic areas. *Contagious ecthyma* (“orf”, Parapoxvirus) causes pustular lesions on lips/muzzle and is zoonotic[37].
- **Foot-and-Mouth Disease (FMD):** Traditionally thought rare in camelids, recent evidence shows Bactrians can contract and transmit FMD (picornavirus), though NW camelids appear resistant[38]. Affected camels develop fever, vesicles on mouth and feet, salivation, lameness; high morbidity/mortality in livestock. Diagnosis by virus isolation or PCR from vesicles; report immediately. No vaccine is licensed for camels.

- **Other viral diseases:** Peste des Petits Ruminants (PPR, Morbillivirus) can infect camels, causing fever, stomatitis, diarrhea, pneumonia. Camels also get bovine viral diarrhea virus (BVDV): noncytopathic strains cause reproductive loss and persistent infection (alpacas more susceptible)[39]. West Nile Virus causes ataxia or blindness (dead-end hosts)[39]. Equine herpesvirus-1 has been reported (rare encephalitis). *Middle East Respiratory Syndrome Coronavirus (MERS-CoV)*: dromedaries are reservoir and develop only mild URI signs, but shed virus to humans[40].
- **Bacterial diseases:** Brucellosis (*Brucella melitensis, B. abortus*) occurs in camels (often from contact with infected sheep/goats) causing late-term abortions and orchitis; camel milking can pose zoonotic risk. Tuberculosis (*Mycobacterium bovis, M. avium* complex) is increasingly diagnosed (especially M. bovis)[41], with chronic weight loss and occasional coughing. Johne's disease (*Mycobacterium avium* ssp. *paratuberculosis*) causes chronic cachexia, edema and intermittent diarrhea[42]. Clostridial enterotoxemia (esp. *C. perfringens* types C, D, and especially type A in young crias) causes acute, often fatal gastroenteritis[43]; vaccinate dams with polyvalent toxoid (including type A toxin if local). Anthrax (*B. anthracis*) has been reported; vaccinate only in endemic areas[44]. *Mycoplasma haemolamae* causes hemolytic anemia, transmitted by biting flies. Listeriosis (CNS disease) and salmonellosis (enteritis/septicemia) also occur sporadically.
- **Protozoa:** *Coccidiosis* (multiple *Eimeria* spp., esp. *E. macusaniensis* in camelids) causes diarrhea and weight loss in young; diagnosed by fecal flotation (oocysts)[45]. *Cryptosporidium parvum* and *Giardia* cause neonatal diarrhea. *Toxoplasma gondii* can cause late-term abortion.
- **Parasitic helminths:** Camelids harbor trichostrongylid nematodes (e.g. *Ostertagia*, *Haemonchus*, *Nematodirus*), and lungworms (*Dictyocaulus viviparus*) similar to small ruminants. Pelleted feces often cause false-negative fecal egg counts. *Haemonchus* ("barber pole worm") causes anemia and bottle jaw. Treat based on local resistances; ivermectin, moxidectin, levamisole are used, often with combination (e.g. levamisole + closantel). Regular fecal egg count monitoring (FAMACHA or immunologic testing) and pasture management are key.
- **Ectoparasites:** Sarcoptic mange (*Sarcoptes scabiei* var. *cameli*) causes intense pruritus and crusting (often called "munge" when severe dermatitis in muzzle/face)[46]. Diagnosis by skin scrapings or biopsy[47]; treat with ivermectin or selamectin. Lice and keds (*Hippobosca camelina*) cause seasonal irritation. Flystrike (blowfly larvae) can occur in sheared NW camelids in warm climates. Oestrus ovis (nasal botfly) infests the nasal passages of sheep/goats, rarely camels.
- **Metabolic and Nutritional Diseases:** Hypocalcemia may occur around parturition (milk fever). Vitamin deficiencies (e.g. copper: depigmented fleece, poor growth[48]) and trace mineral imbalances (Ca:P ratio, Se) cause poor growth, ataxia. **Hyperglycemia/insulin resistance** has been observed in obese camelids, akin to equine metabolic syndrome. Some dromedaries get "fescue toxicosis" by ingesting endophyte grass. Urolithiasis (struvite or silica stones) is rare but reported in older castrated males. Fatty liver (hepatic lipidosis) can complicate negative energy balance.
- **Trauma and Neoplasia:** Camelids may suffer injuries (car accidents, kicks, falls). Camel-specific injuries include shoulder/axilla trauma from loads or entanglement. Neoplasms are uncommon; squamous cell carcinoma of the eye and sarcoids have been reported.
- **Congenital Anomalies:** Choanal atresia (failure of nasal openings) is common in NW camelid neonates[28] and is an emergency if bilateral. Additional defects include wry face

(maxillofacial dysgenesis), choanal atresia and cardiac murmurs. Polioencephalomalacia (thiamine deficiency) is possible if fed high-grain diets.

[49][47] *Sarcoptic mange ("Munge")*: An adult alpaca with severe nasal crusting was found to have skin scrapings positive for *Sarcoptes*, a diagnosis confirmed by skin biopsy. Treatment with ivermectin resolved the lesions. Dermatitis differential diagnoses include orf and dermatophilosis.

Diagnostic Approach

Diagnosis relies on history, clinical signs, and targeted testing. A **systematic clinical exam** is described above. Common **laboratory tests** include: CBC/chemistry (often showing hemoconcentration in dehydration, stress leukogram), serology (e.g. brucellosis, Johne's ELISA), fecal flotation/PCR (nematodes, coccidia, Johne's PCR), and cultures or PCR on swabs/fluids (FMD, tuberculosis). Imaging: radiographs can detect pneumonia (especially aspiration pneumonia) or skeletal injuries; ultrasound is useful for abdominal evaluation (pregnancy, free fluid, C3 ulcers) and thoracic pleural fluid. Endoscopy (via nose) can visualize esophageal or gastric ulcers. Necropsy remains definitive for many infectious diseases.

Treatment and Management

Therapy of camelid diseases parallels other livestock, adjusted for species differences and drug tolerances. **Supportive care** (fluids, electrolytes, nutritional support) is often critical. **Antimicrobials:** Broad-spectrum antibiotics (penicillin, oxytetracycline, ceftiofur, enrofloxacin) are used for bacterial infections (pneumonia, sepsis, wound infections). Pasteurellosis (e.g. *Mannheimia* spp.) may require sulfa+trimethoprim or oxytet. Amphotericin B or azoles for systemic mycoses. Anti-inflammatories (flunixin, meloxicam) for pain/fever.
Parasite control: For nematodes and lice/mange, ivermectin (0.2–0.4 mg/kg SC) or moxidectin (0.4 mg/kg) are effective[47]. For coccidiosis, treat with amprolium (10 mg/kg PO q24h) or sulfadimethoxine (15 mg/kg q12h)[45].
Vaccination: Limited licensed vaccines exist for camelids. In practice, off-label use of cattle/sheep vaccines is common: clostridial C/D + tetanus toxoid annually; pasteurella (in endemic areas); rabies (as indicated); anthrax (endemic zones only). *Camelpox vaccine* (live attenuated) is available in some countries to prevent outbreaks. Biosecurity and quarantine of new herd members for 30–60 days with fecal exams and testing for Johne's/TB is vital. Fly control and insect-proof housing reduce vector-borne diseases. Rotational deworming and pasture management (avoid overcrowding) prevent parasitic outbreaks.
Treatment protocols: Each disease has specific protocols (see common diseases table). For example, acute pneumonia: broad-spectrum antibiotics for 5–7 days[50], combined with NSAIDs and fluids if needed. Johne's: no cure – isolate or cull positive animals[42]. Caseous lymphadenitis (Corynebacterium): lance abscesses, surgical excision, long-term erythromycin if systemic. Mange: ivermectin injections (0.2–0.4 mg/kg, 2–4 treatments at 10–14 day intervals) plus antibiotic for secondary infections[47]. Cryptosporidiosis: supportive fluids; paromomycin may be attempted.

Prevention and Herd Health

Preventive medicine is crucial. **Husbandry:** Provide dry, well-bedded shelter; shade and dust baths (alpacas); gentle handling (they spit when angry). Provide adequate colostrum (tube-feed if orphaned) and ensure early bonding. Regular hoof trimming (camels), shearing (NW camelids spring/shear to remove 50–70% fleece). Nutrition: balanced rations with trace mineral supplementation.

Biosecurity: Isolate new additions and test for TB, Johne's, and brucellosis. Use separate equipment and disinfection between groups. Control rodents and predators. Ensure clean water and feed to prevent bacterial contamination.
Vaccination & Deworming: As above. Monitor parasite loads by fecal egg counts; rotate classes of dewormers to avoid resistance. Apply ectoparasite control (insecticidal sprays or pour-ons for flies, lice seasonally). Keep common vaccines up to date (tetatnus toxoid is included in most multidose vaccines).
Nutrition management: Avoid overeating grain (ketosis, acidosis). During late pregnancy and lactation, increase energy needs. Monitor body condition (score 1–5) and adjust rations.
Routine care: Vaccinate dams 4–6 weeks pre-partum with clostridial toxoid. Weigh crias regularly. Perform fecal parasite tests twice a year. Dental floats annually if malocclusion. Spay/neuter unwanted animals.
Monitoring: Keep records of births, deaths, production (milk, fiber yield). Conduct necropsies on sudden deaths to detect diseases (e.g. anthrax, poisoning). Consider herd health visits from veterinarians biannually.

Economic Importance

Camelids provide diverse products and services. Dromedary camels are vital in Middle Eastern/African economies: used for meat (low-fat, protein-rich), milk (nutritious, tolerant to lactose-intolerant people), transport (pack animals), and tourism (riding). Bactrian camels in Central Asia are prized for wool and as beasts of burden. NW camelids are farmed for high-quality fiber (alpaca wool is luxury textile) and meat (in South America). Guanaco and vicuña fiber is very fine and expensive (wild vicuña wool is regulated by quota programs).
Production statistics: ~15 million domestic camels worldwide, 85% dromedary, ~80% in Africa. Global camel meat output exceeds 50,000 tons/year, with carcass yields ~50–60%[51]. Llama and alpaca industries are smaller but growing in the U.S., Australia, and Europe for fiber and breeding stock. Fiber yields: alpacas ~2–7 kg fleece/year, llamas ~5–8 kg[23]. Camel milk yield: single-humped camels ~20–30 liters/day under good management.
Zoonotic risks factor into economics (e.g. MERS surveillance, Brucella control). Camelid husbandry supports nomadic and indigenous peoples and is a focus of agricultural development (FAO, OIE programs). In addition, camel blood (with oval RBCs) has been studied for medical use, and camels have been used in therapy riding programs.

Welfare and Husbandry Recommendations

High welfare standards improve productivity. Provide sufficient space: 5–10 m^2 per alpaca, larger pastures for camels. Enrichment: allow dust-bathing (NW camelids), group housing for social bonding (camelids are herd animals). Handle calmly to prevent stress-induced injuries. Avoid prolonged trekking in extreme heat; allow rest with cooling (misters, fans)[4]. Monitor for heat stress in summer (panting, mucosal redness) and cover lightly in cold. Shaded areas and windbreaks in desert environments. For pregnant females, gentle handling and calm birthing environment are important.
Regular health checks and preventive care (as above) are welfare pillars. In transport, pack camels so they are balanced (heavy loads over hump, leg straps to control foot movement). Train animals for haltering and veterinary procedures early. In captivity, maintain ranges of appropriate substrates to avoid foot pad injuries (soft ground). Provide continual fresh water (they will drink heavily when thirst returns). Vaccinate painlessly (subcutaneous or low-volume injections) and watch for adverse reactions (anaphylaxis can occur with any vaccine).

Ethical slaughter of camelids should follow national standards; for example, they may be stunned by captive bolt like other large animals. Notably, llamas have “supraorbital pigmentation syndrome” that can interfere with electrical stunning, so knife stunning under heavy anesthesia may be used. Avoid breeding animals with severe congenital defects (e.g. bilateral choanal atresia, immune deficiency syndromes) to improve long-term herd health.

Conclusion

Camelids are a unique group of even-toed ungulates with distinctive anatomy and physiology geared towards survival in extreme habitats. Their management in veterinary practice requires understanding species-specific adaptations and diseases. Careful attention to nutrition, housing, and preventive health greatly reduces morbidity and mortality in these animals. Early recognition of illness, coupled with prompt diagnostics and appropriate therapy (tailored from ruminant and equine medicine) can save lives. A holistic approach – combining clinical vigilance, herd health planning, and welfare considerations – ensures productive camelid populations. Veterinarians must appreciate Camelidae’s comparative differences (e.g. three-chambered stomach, induced ovulation, foot pads, temperature tolerance) to effectively treat and advise livestock owners. Proper neonatal care and biosecurity are paramount to maintain herd viability. Ongoing research (e.g. improved vaccines, antiparasitic strategies) continues to advance camelid medicine.

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